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**PORTABLE DIGITAL AUDIO RECORDER AND PLAYER
WITH HOUSING AND HINGED DOOR**

Field of the Invention

The present invention relates to a portable digital audio recorder and player and more particularly to a miniature disk drive having a hinged door for receiving a floppy disk
5 for recording and playing back the audio in a digital format.

Background of the Invention

Portable audio players have been used since miniaturization made them technologically feasible. The Walkman™ is a small portable stereo player used with headphones. It typically functions as a radio and/or a cassette player.

10 Quickly following the introduction of compact disks CD which include digital audio information, and CD players which are devices designed for playing the audio information stored on the disks, the CD players were miniaturized to become portable. Such portable CD players are known as Diskman™.

PATENT

In digital audio recording an input audio waveform is sampled and each sample has a digital value. Digital CD technology is superior to analog audio tape in terms of durability and quality, however it is not widely amenable for personal recording of audio information.

5 A recent development in portable audio players is the chip based digital player which enjoys both the quality and durability of compact disks and which is readily amenable for personal recordings. A digital audio player includes an audio chip and a memory which serve to record, store and subsequently play digital audio information. Typically, an audio chip is also designed to compress and decompress audio digital data in order to save memory
10 space. Digital audio players became feasible with the evolution of miniaturized high capacity digital memory devices and digital information compression technologies. MP3, MP4, AT&T, a2b, Liquid Audio, Real Audio and SDMI audio players are used. These players enable the download, storage and subsequent play of compressed digital audio information from the Internet.

15 In 1992, the MPEG standard was defined by the Moving Picture Experts Group, a working group of the International Standards Organization and International Electrotechnical Commission. This standard, now called MPEG-1, is for the coding of moving pictures and associated audio for digital storage. The standard was published in 1993. Audio Compression was standardized as ISO-MPEG-1 Audio Layer-3 now known as "MP3".
20 U.S. Patent 6,601,306, Buchheim describes a portable audio recorder and player for recording information in a digital format. The Diamond Rio player records and plays music in the MP3 Format.

 U.S. Patent 5,809,520, Edwards, et al. shows and describes a miniature disk drive having a miniature cartridge compatible with different types of devices. The miniature
25 drive and miniature cartridge of that patent are referred to as the Klik!™ drive and Klik!™ cartridge made by Iomega Corporation, Roy, Utah. This drive and cartridge are shown in more detail in U.S. Patents 5,969,915, Patterson; 5,995,346, Schick, *et al.*; 5,999,382, Muse, *et al.*; 6,005,755, Muse, *et al.*; and 6,021,031, Hales, *et al.*.

It is an object of the present invention to provide a portable digital audio recorder and player having a miniature disk drive with a miniature cartridge, having a floppy disk.

Summary of the Invention

5 A floppy disk drive records audio in a digital format and plays back the digital information which is converted to an analog form so it can be played back as audio, such as music. The digital audio is in a compressed format such as MP3 which can be transmitted over the Internet.

 In accordance with the present invention, a device including the floppy disk
10 drive has a housing and a door through which the floppy disk is inserted for recording and playback. Further in accordance with the invention, the door has a hinge which can be opened to a position so that the door extends beyond the plane of the housing to permit insertion of the disk.

 The door opens further than 90° so that the cartridge can be inserted into the
15 drive. The invention allows this without adding extra length to the housing which otherwise would be needed to accommodate a hinge which rotates fully.

Brief Description of the Drawings

 The foregoing summary, as well as the following detailed description of the
20 preferred embodiments, is better understood when read in conjunction with the attached drawings. For the purpose of illustrating the invention, there is shown in the drawings embodiments that are presently preferred, it being understood, however, that the invention is not limited to the specific apparatus, system, and instrumentalities disclosed. In the drawings:

 FIG 1 is a prospective view showing the front and side of an exemplary digital audio
25 device according to the present invention;

 FIG. 2 is a side view showing the top of the digital audio device of FIG. 1 with the door in the open position;

FIG. 3 is a prospective view showing the front and side of the digital audio device with the door open and an exemplary storage medium inserted according to the present invention;

FIG. 4 is a perspective view of an exemplary data storage device, or disk drive, and an exemplary storage medium that can be used with the present invention;

5 FIG. 5 is a top plan view of the disk drive of FIG. 4;

FIG. 6 is a rear view from the side of the digital audio device of FIG. 1;

FIG. 7 is a prospective view showing the top of the digital audio device of FIG. 1 with the back housing removed exposing the disk drive unit;

FIG. 8 is a prospective view showing the top of the digital audio device with the disk
10 drive unit "unfolded" exposing the connector board.

FIG. 9 is a prospective view showing the top and side of the digital audio device with the back housing removed and the circuitry exposed; and

FIG. 10 is another prospective view showing the top and side of the digital audio device with the back housing removed and with further circuitry exposed according to a
15 preferred embodiment of the present invention.

Detailed Description of the Preferred Embodiment

The present invention provides a portable digital audio recorder and player (hereinafter 'device') having a miniature disk drive with a miniature cartridge having a floppy disk.

20 Referring now to the drawings, there is shown in FIG. 1 a prospective view from the front and left side of the device according to a preferred embodiment of the present invention. FIG. 1 shows an overall external view of the device.

As shown in FIG.1, the device includes a front housing and a rear housing that are combined to form the housing of the device which encases the electrical circuit boards (not
25 shown in this figure) and to provide an overall shape to the device. The device has a top, a bottom, a front, a back, a right side and a left side. In a preferred embodiment, the combination of the front and rear housing gives the device a substantially rectangular shape with concave sides and are made of plastic. The front and rear housing can be made of any suitable material such as metal or the like. The shape and material of the front and rear

housing are not significant as other shapes and materials can be used without departing from the spirit and scope of the present invention. Rubber grips (only one shown in FIG. 1) can be used on each side of the device for maximum gripping capabilities while holding the device with a human hand.

5 There are several features on the exterior of the housing of the device, including a display device, a plurality of interface connections and a plurality of buttons. Preferably, the display device is a LCD which displays information to the user. As shown, a first set of buttons is located on the front housing. The first set of buttons includes a stop button, a play button, a forward button and a reverse button and allows the user to control the music
10 selection and playback. A second set of buttons is located on the left side of the case in the area of the rubber grip. The second set of buttons includes a menu/select button and a scroll button (e.g. up and down arrow). These buttons allow the user to select different options that affect the playing of the digital data. The location and layout of the control buttons are not significant and other button layouts can be used without departing from the spirit and scope
15 of the present invention.

As shown in FIG. 1, the top of the device includes a door. As shown, the door is located on the top of the device. The door is selectively movable between an open position and a closed position. In the open position, the door provides access to the disk drive for insertion and removal of a removable data storage cartridge (not shown in this figure). The
20 door has a latch that engages a shoulder on the bezel and holds the door closed. In the closed position, the door covers the opening to the drive and prevents dirt, dust and/or other contaminants from entering the disk drive. Preferably, as shown, the door can be connected to the case by a hinge mechanism. As shown, the door has a tab and a plurality of arms.

FIG. 2 is a side view from the left and top of the device with the door in the open
25 position. The door is connected to a hinge that allows the door to open to a position so the plane of the door extends past the plane of the rear case, i.e. the hinge allows the door to rotate more than 90 degrees. The housing comprises a detent and one or more hooks that are formed in the case. An elongated pin is inserted through the arms of the door and the hooks on the house to provide the hinging motion. A detent in the case permits the door to open to a

position so that the plane of the door extends past the plane of the housing. This configuration allows for easy insertion and removal of the removable disk cartridge.

The open door exposes a bezel. The bezel has a slot which is used for insertion and removal of a disk (not shown in this figure). FIG. 2 also more clearly shows the second set of
5 control buttons.

FIG. 3 shows a removable disk cartridge which has been partially inserted into the slot of the bezel. The removable disk cartridge has a floppy medium and is used to store digital data including, for example, video, audio and the like for use in the device. In the preferred embodiment, the disk used is a Klik!ä disk manufactured by the Iomega Corporation, Roy,
10 Utah.

FIG. 4 is a perspective drawing of an exemplary disk drive device 50 and an exemplary disk cartridge 10. Drive 50 may be adapted for removable connection to a computer device or may be built-in to a computer device (not shown). Preferably, disk drive device 50 has a form factor such that it may be adapted for use with a digital audio recorder
15 and player device. Disk drive device 50 may have a protective case, such as protective case 53, consisting of an upper case 54 and a lower case 55, which form an interior space for accepting disk cartridge 10. Upper case 54 and lower case 55 are preferably formed from sheet material. Lower case 55 has a bottom surface and side surfaces, and upper case 54 is formed so that it covers the top of lower case 54. Upper case 54 may also have a raised
20 surface 54a, which projects upward across a width of the upper case 54.

A connector 15 (shown in phantom in Figure 4) is provided in one end of protective case 53. As noted, preferably the external dimensions of the protective case 53 are in a form which conforms to the PCMCIA standards, preferably Type II. According to the standard, the form factor should conform to a length of about 85.6 mm, and a width of about
25 54 mm. By conforming to this standard, drive device 50 can be adapted for insertion into the case of the digital audio device. Furthermore, when disk drive device 50 is inserted into the digital audio device, connector 15 connects to a corresponding connector within the device such that a power source and electrical signals can be transmitted and received between disk drive device 50 and the device.

Figure 5 is a top plan view of the internal components of the exemplary disk drive 50 of Figure 4 with the upper case 54 removed for clarity. Drive 50 further comprises a chassis 57, an actuator 49, a spindle motor 52 and a spindle 40, and load ramps 47. The actuator is itself comprised of three major components: (1) a pair of load beams 44 with (2) a read/write head 46 disposed at the distal end of each load beam 44, and (3) a coil 43. Actuator 49 is driven by a voice coil to pivots about point 51. When actuator 49 is not in use, it is generally retracted to the parked position (as shown).

A disk cartridge 10 can be inserted into an opening 48 in the front of drive 50 in the direction indicated by the arrow. During insertion, the disk 10 slides linearly along the top surface of chassis 57 and spindle motor 52 for engagement with the read/write heads 46.

FIG. 6 is a prospective view showing the right side and rear of the device. As shown, the right side includes a headphone jack, a power supply connection, a lock button and a mini USB (Universal Serial Bus) cable connection. The headphone allows the user to plug in headphones to the device as to enable only the user to hear the music. The power supply allows the user to connect the device to an external power supply. The lock button enables the user to selectively activate or deactivate the other control buttons. The mini USB cable connection allows the user to exchange data directly with an external device, such as a personal computer or other compatible devices. The location and arrangement of these features are not significant and using a different layout would not depart from the spirit and scope of the present invention.

FIG. 7 is a prospective view from the top of the device with the back housing removed exposing the disk drive unit for clarity. FIG. 7 shows the disk drive unit which accepts the removable disk cartridge (not shown) after it is inserted through the bezel (also not shown). In the preferred embodiment, the disk drive unit is a Clik! drive as manufactured by the Iomega Corporation, Roy, Utah.

FIG. 8 is a prospective view from the top of the digital audio device with the disk drive unit "unfolded" exposing the connector board.

The connector board can communicate with the disk drive via an electrical connector. The connector board has input circuitry for receiving audio in a digital format and output circuitry for recording audio in a digital format. The connector board also has a digital to

analog converter for which produces the analog voltage for the headphone jack. Preferably, as shown, a flex circuit is used to connect the disk drive and the connector board. Flex circuit is preferred because the flex circuit allows the disk drive and the connector board to be stacked on top of one another. This "stacking" minimizes the overall form factor of the device and enables the device to be easily carried in the palm of the hand.

An insulation shield may be placed between the "stacked" connector board and disk drive to prevent noise interference between each component. Preferably, as shown, a copper shield, laminated with Mylar, is used to prevent electromagnetic interference and electrical shorting between the boards.

FIG. 9 is a prospective view from the top and side of the device with the back housing removed and the circuitry exposed according to a preferred embodiment of the present invention. As shown in FIG., the device includes a battery, a battery clip, and a connector board. The battery provides power to the device and is held in place by the battery clip. The battery hold down clip includes a support bar, upwardly extending alignment members and downwardly extending side bars with grasping flanges. The side bars extend downwardly (e.g. towards the front housing) and along with the flanges serve to hold the battery in place. The flanges can grasp onto the housing in several ways. Preferably, as shown, the flanges grasp slots in the housing to secure the battery. The alignment bars extend upwardly (e.g. towards the rear housing) and serve to align the disk drive unit and provide back up support in case of failure of the flanges.

The battery is connected to the connector board by an electrical connector. The connector board includes interface connections for the headphone jack, power supply, lock button and mini USC cable.

FIG. 9 also shows the LCD board. The LCD board displays information to the user. The LCD board can be mechanically connected to the connector board. Preferably, as shown, the LCD board and the connector board are connected with screws. The LCD board and the connector are also electrically connected. Preferably, as shown, the connector board has a plug and the LCD board has a mating receptacle which allows the boards to communicate. The LCD board is also "stacked" on top of the button board. This additional "stacking" minimizes form factor and makes the device small enough to carry in the human hand.

The button board can be mechanically connected to the LCD board. Preferably, as shown, the LCD board is connected to the button board with a screw. The LCD board and the button board can also be electrically connected. Preferably, as shown, the LCD board and the button board communicate through a plug and receptacle configuration.

- 5 FIG. 10 shows another prospective view from the top of the digital audio device with the back housing removed with further circuitry exposed according to a preferred embodiment of the present invention. FIG. 10 shows the LCD board, connector board, disk drive, battery and battery clip removed from the housing to expose the button board. The button board can be mechanically connected to the housing. Preferably, as shown, the button board is screwed
- 10 into the front housing. The stop button, play button, forward button and reverse button are connected to the button board and extend through holes in the front housing (not shown) in order for the user to press them.

What is claimed is:

1. A device for recording audio in a digital format and playing back said audio, said device comprising:
 - input circuitry for receiving said digital format;
 - output circuitry for playing back the audio recorded in a digital format;
 - a housing;
 - a miniature disk drive in said housing having a miniature floppy disk for recording said audio in said digital format;
 - an opening at one end of said housing for insertion of said disk into said housing;
 - a door at said one end of said housing, said door having a hinge including:
 - at least one hook formed in said housing;
 - arms at the ends of said door,
 - an elongated pin inserted through said hook and said arms so that said door can pivot thereon; and
 - an indent in said housing permitting said door to open to a position so that the plane of the door extends beyond the plane of said housing.
2. The device recited in claim 1 wherein said housing comprises a front and rear housing which enclose said disk drive.
3. The device recited in claim 1 further comprising a battery and a clip to hold said battery in said housing said clip having two upstanding arms to hold said disk drive between them.

4. The device recited in claim 1 wherein said door has a tab and wherein said tab moves through said indent to allow said hinge to rotate more than 90°.

5. The device recited in claim 1 further comprising:
a bezel, said bezel being mounted in said opening, said bezel having a slot for insertion and removal of said disk.

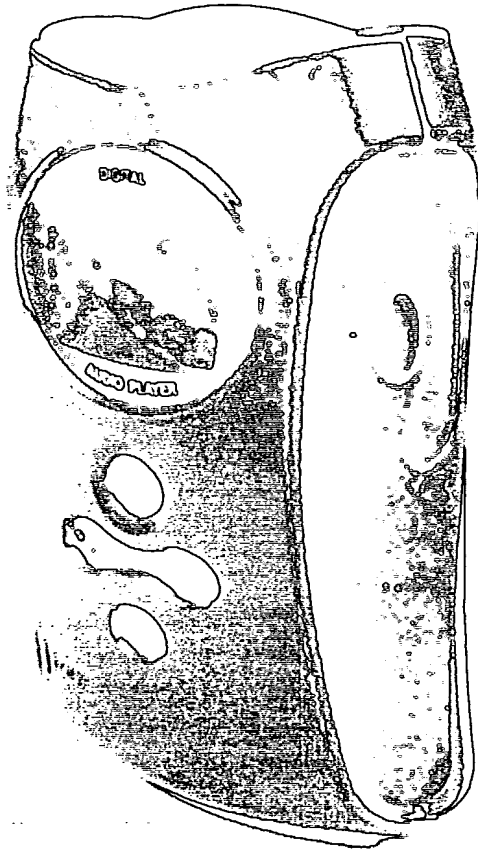


Fig. 1

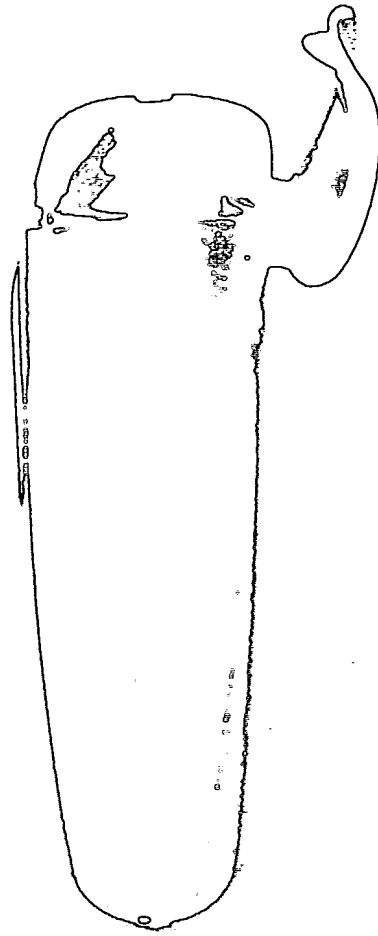
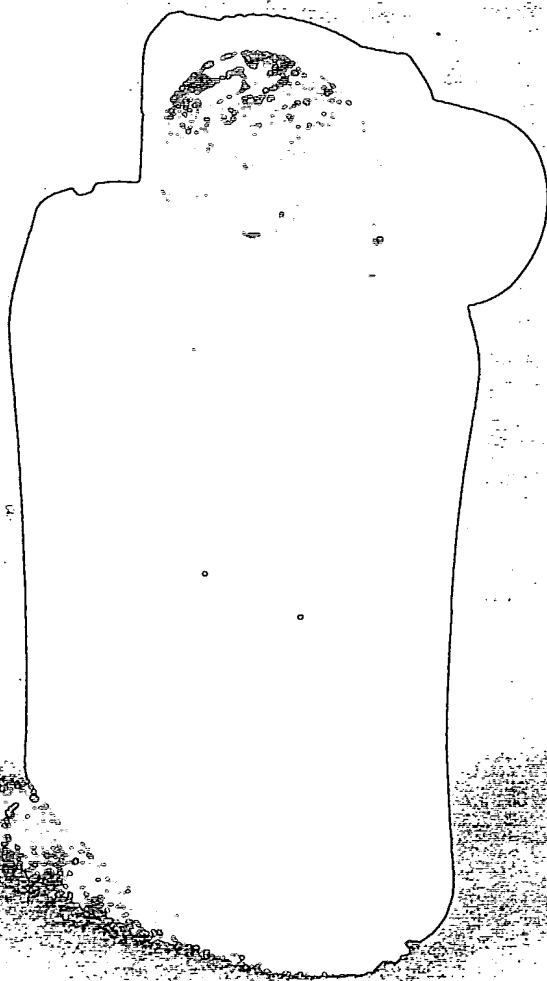
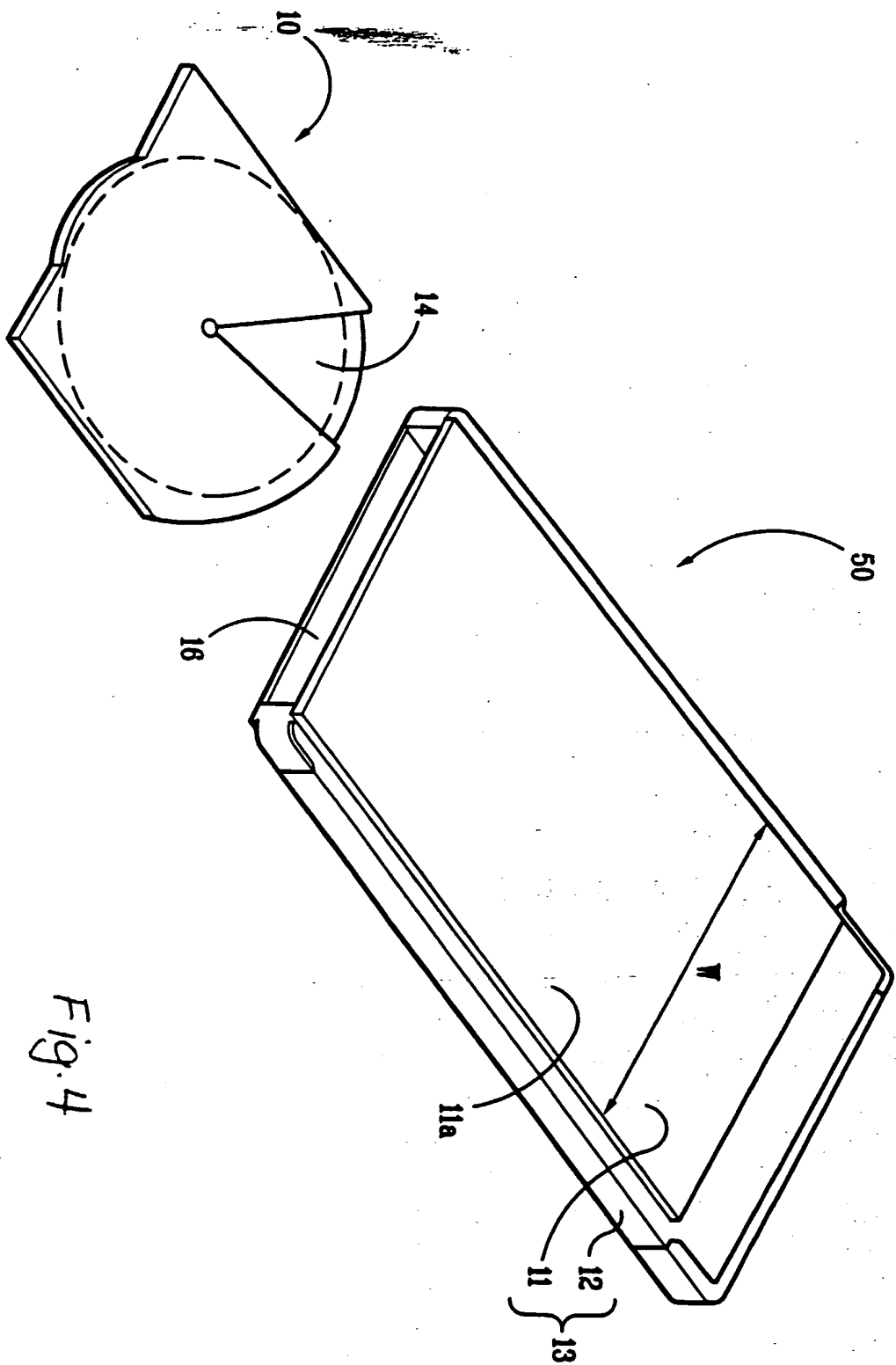


Fig. 2

Fig. 3





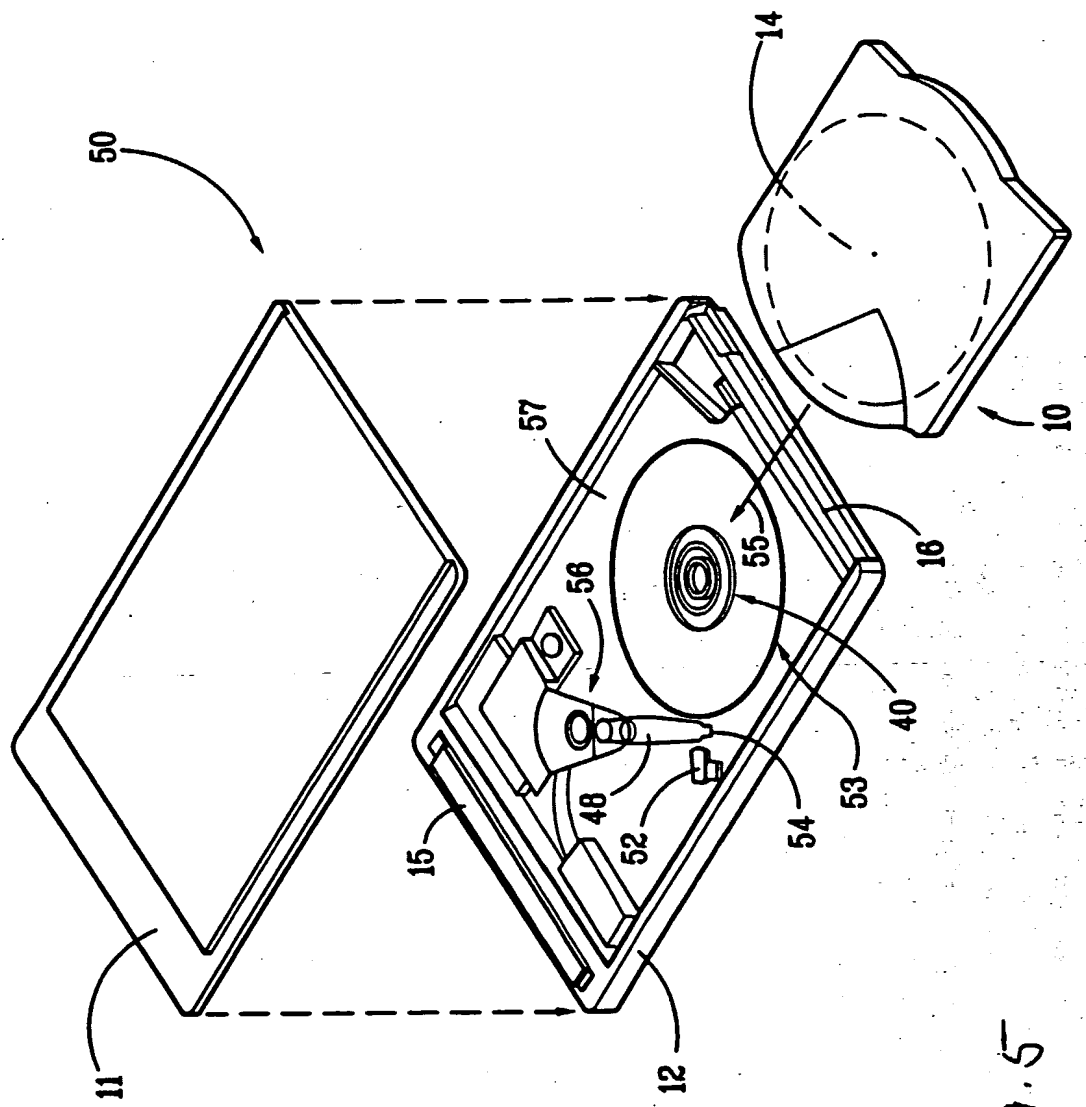


Fig. 5

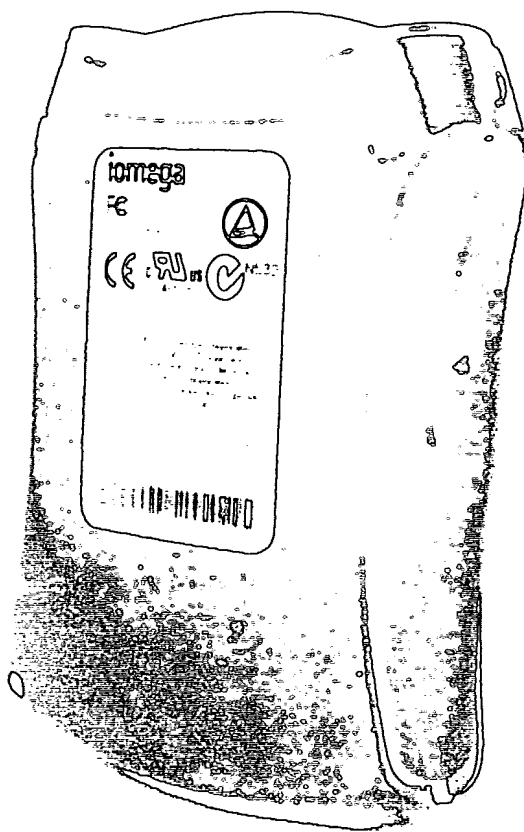


Fig. 6

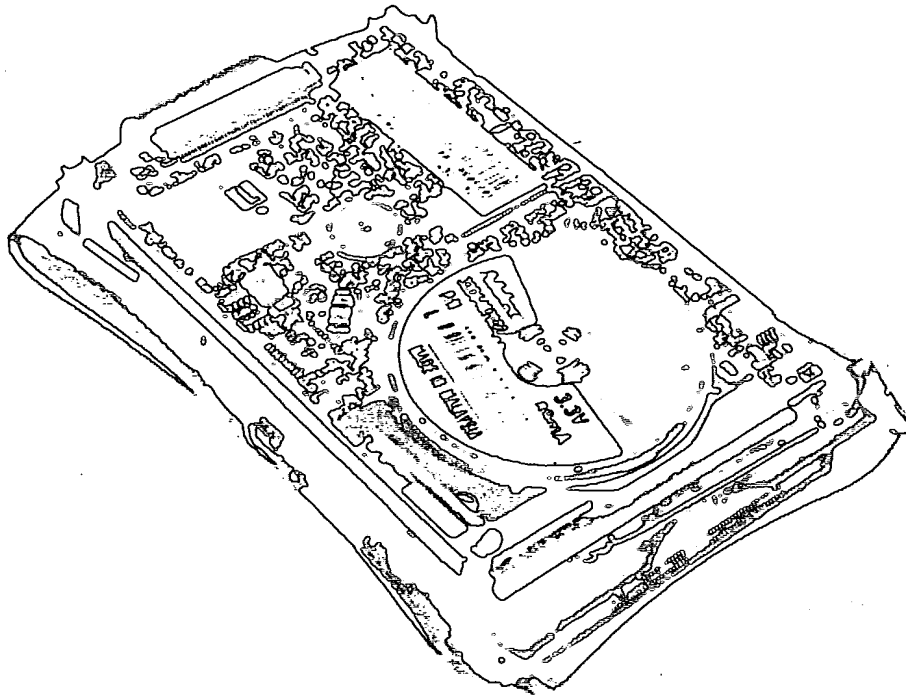


Fig. 7

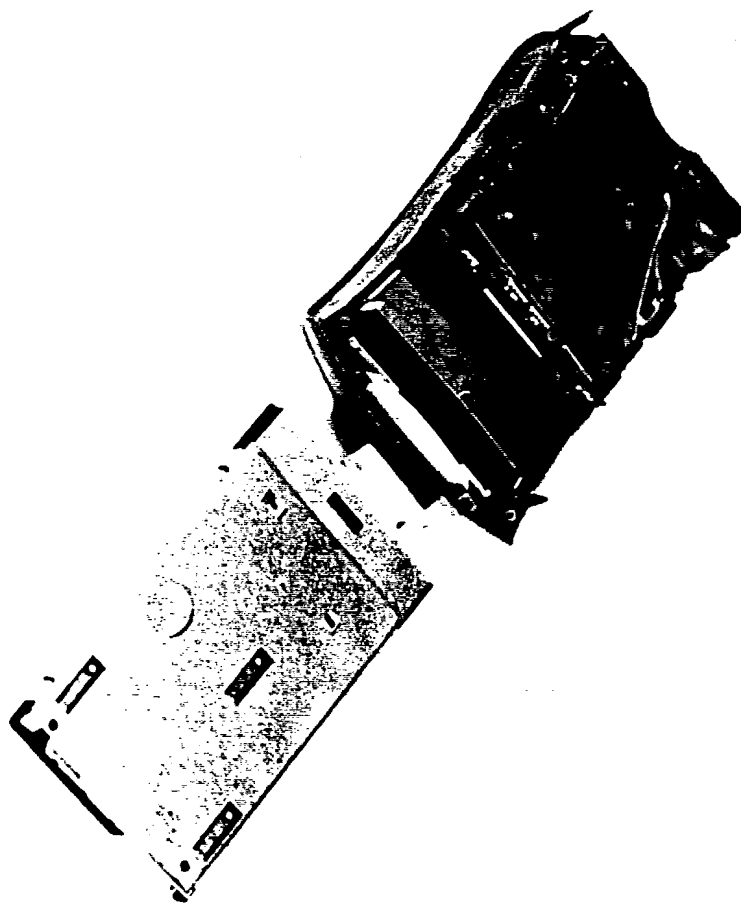


Fig. 8

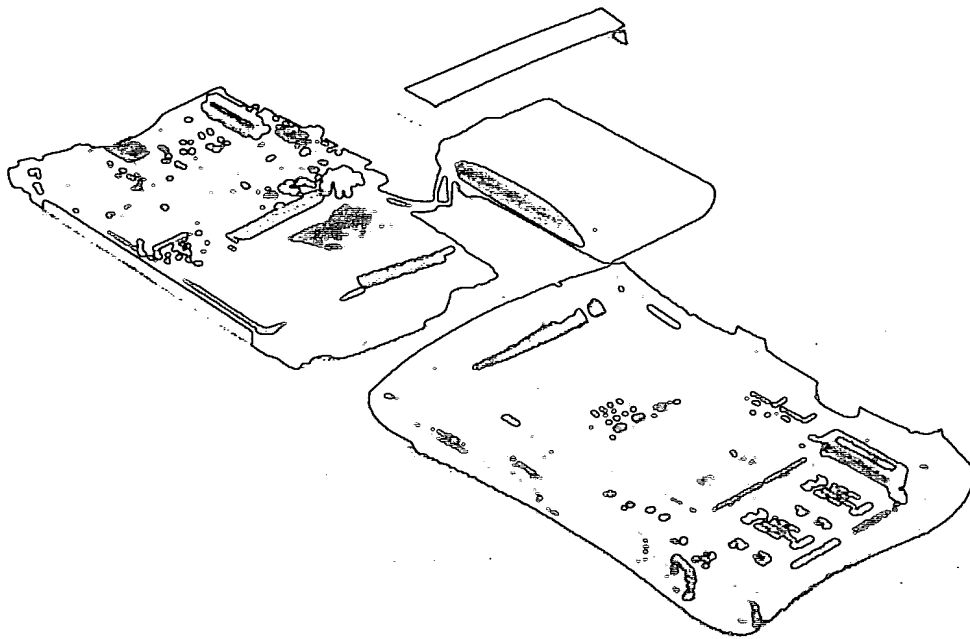


Fig. 9

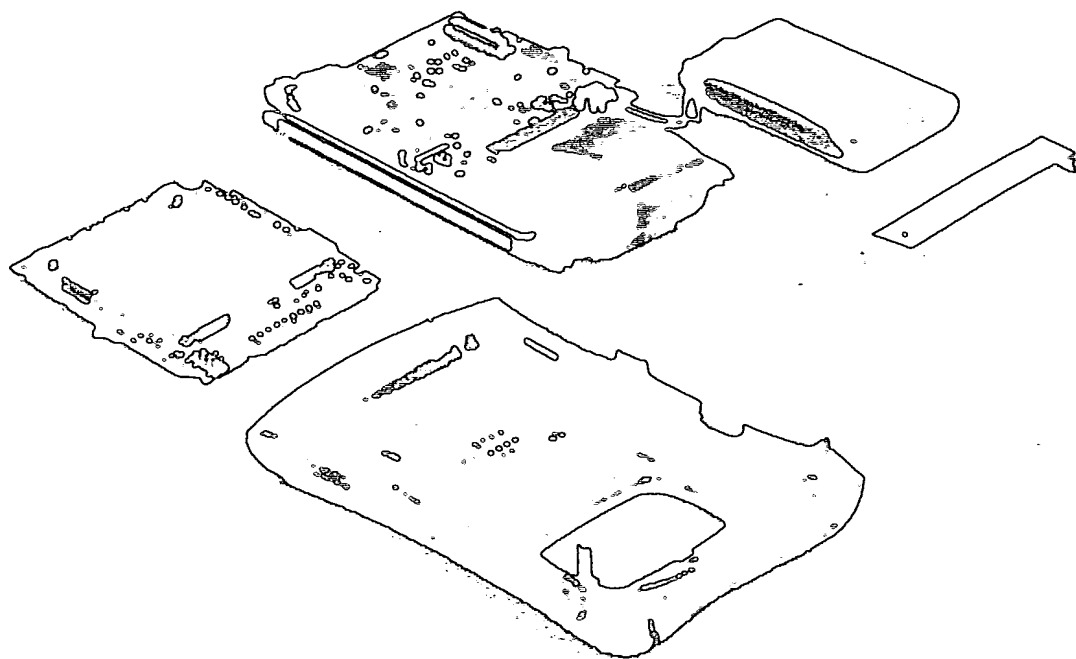


Fig. 10